

ARMY RESEARCH LABORATORY



## An Initial Investigation of Factors Affecting Multi-Task Performance

by **Teresa A. Branscome, Jennifer C. Swoboda, and Linda T. Fatkin**

ARL-TR-4025

February 2007

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## **An Initial Investigation of Factors Affecting Multi-Task Performance**

**Teresa A. Branscome, Jennifer C. Swoboda, and Linda T. Fatkin**  
**Human Research and Engineering Directorate, ARL**

# REPORT DOCUMENTATION PAGE

Form Approved  
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1. REPORT DATE (DD-MM-YYYY) February 2007	2. REPORT TYPE Final	3. DATES COVERED (From - To)		
4. TITLE AND SUBTITLE  An Initial Investigation of Factors Affecting Multi-Task Performance			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)  Teresa A. Branscome, Jennifer C. Swoboda, and Linda T. Fatkin (all of ARL)			5d. PROJECT NUMBER 62716AH70	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  U.S. Army Research Laboratory Human Research and Engineering Directorate Aberdeen Proving Ground, MD 21005-5425			8. PERFORMING ORGANIZATION REPORT NUMBER ARL-TR-4025	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT  Approved for public release; distribution is unlimited.				
13. SUPPLEMENTARY NOTES				
<p><b>14. ABSTRACT</b></p> <p>This report presents the results of the first in a series of investigations designed to increase fundamental knowledge and understanding of the factors affecting multi-task performance in a military environment. The primary objective of this laboratory experiment was to measure and quantify the effects of individual differences on human performance in a multi-task environment. The secondary objective was to observe the effects of previous computer experience and practice and to determine which relationships, if any, exist between personality and self-efficacy traits and multi-task performance.</p> <p>In this study, each of 76 civilian and military participants completed a battery of questionnaires designed to gather information about individual differences. Included were a demographics questionnaire that solicited information regarding age, gender, vision and hearing, military service, and computer use and experience; the Zuckerman-Kuhlman Personality Questionnaire Form III which identifies five components of personality in five subscales including activity, aggression-hostility, sociability, neuroticism-anxiety, and impulsive risk-taking; the polychronicity scale which measures the extent to which individuals prefer working on several tasks at once as opposed to working on only one task at a time; and the Situational Self-Efficacy (SSE) scale which measures the participants' level of confidence in their ability to do a task well. After completion of the questionnaires, multi-task performance was measured using SYNWORK (Synthetic Work Environment), a computer-based synthetic work environment that runs on a personal computer or a laptop (Elsmore, 1994). Participants were required to work simultaneously on four distinct tasks that were presented on a computer screen: Sternberg memory, three-column addition, visual tracking, and signal discrimination. These tasks required continuous attention and involved memory, arithmetic processing, and visual and auditory monitoring.</p> <p>Pearson correlation coefficients were computed to determine relationships between questionnaire responses and SYNWORK scores. Overall SYNWORK scores showed a significant negative correlation with age group, neuroticism, and impulsivity, and a significant positive correlation with trial. In addition, significant positive correlations existed between total SYNWORK scores and components of the polychronicity scale. Results indicated that participants who preferred working on several projects at a time scored higher overall on the SYNWORK task.</p>				
(abstract continues on next page)				
15. SUBJECT TERMS  individual differences; multi-tasking; SYNWORK				
16. SECURITY CLASSIFICATION OF:		17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 47	19a. NAME OF RESPONSIBLE PERSON Teresa A. Branscome
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified	19b. TELEPHONE NUMBER (Include area code) 410-278-5951	

#### Item 14 continued

Multivariate analyses conducted on individual and overall task performance measures indicated a significant interaction between age group and trial. Consistent with our expectations, it was found that initially, younger adults performed better on multi-task performance, but all age groups improved performance with practice.

Multiple regression analyses were conducted on overall task performance measures. The variable that is consistently retained at the end of the stepwise regression analyses is the N-Anxiety subscale of the personality questionnaire. Those less prone to emotional upsets or worrying performed better at multi-task monitoring than people who were more reactive and sensitive to criticism. When age, education level, and neuroticism were included in the model, 32.5% of the variance was explained.

Cluster analysis was used to examine the effect of individual differences on the performance outcome. An analysis of the SSE variable revealed two distinct groups of individuals with high and low levels of confidence in their ability to do well. *Post hoc* analyses indicated that people who reported high SSE performed significantly better at multi-task monitoring than those who reported lower SSE level.

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## Executive Summary

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This report presents the results of the first in a series of investigations designed to increase fundamental knowledge and understanding of the factors affecting multi-task performance in a military environment. The primary objective of this laboratory experiment was to measure and quantify the effects of individual differences on human performance in a multi-task environment. Within the Army, it is important to determine if differences in age in military-effective target audiences, that is, ages 18 through 55, have an effect upon performance in multi-task environments. That is, can performance be expected to remain the same across all age groups? The secondary objective was to observe the effects of previous computer experience and practice and to determine which relationships, if any, exist between personality and self-efficacy traits and multi-task performance.

In this study, each of 76 civilian and military participants completed a battery of questionnaires designed to gather information about individual differences. Included were

- a demographics questionnaire that solicited information regarding age, gender, vision and hearing, military service and computer use and experience;
- the Zuckerman-Kuhlman Personality Questionnaire Form III which identifies five components of personality in five subscales including activity, aggression-hostility, sociability, neuroticism-anxiety, and impulsive risk-taking;
- the polychronicity scale which measures the extent to which individuals prefer working on several tasks at once as opposed to working on only one task at a time; and
- the Situational Self-Efficacy scale which measures the participants' level of confidence in their ability to do well on the task at hand.

After completion of the questionnaires, multi-task performance was measured by SYNWORK (Synthetic Work Environment), a computer-based synthetic work environment that runs on a personal computer or a laptop (Elsmore, 1994). Participants were required to work simultaneously on four distinct tasks that were presented on a computer screen: Sternberg memory, three-column addition, visual tracking, and signal discrimination. These tasks required continuous attention and involved memory, arithmetic processing, and visual and auditory monitoring. Following verbal instructions and a demonstration of each SYNWORK task, participants completed two 5-minute training sessions, each followed by a 5-minute break. Minimal training ensured that the participants were familiar with how to perform the tasks; concerted effort was still required at attention allocation. Participants then completed four 12-minute trials with a mandatory 5-minute break between each trial.

Pearson correlation coefficients were computed to determine relationships between questionnaire responses and SYNWORK scores. Overall, SYNWORK scores showed a significant negative correlation with age group, neuroticism, and impulsivity. Trial exhibited a significant positive

correlation with math, memory, and total SYNWORK scores. In addition, significant positive correlations existed between total SYNWORK scores and components of the polychronicity scale. Results indicated that participants who preferred working on several projects at a time scored higher overall on the SYNWORK task.

Multivariate analyses conducted on individual and overall task performance measures indicated a significant interaction between age group and trial. Consistent with our expectations, it was found that initially, younger adults performed better on multi-task performance, but all age groups improved performance with practice.

Multiple regression analyses were conducted on overall task performance measures. The variable that is consistently retained at the end of the stepwise regression analyses is the N-Anxiety subscale of the personality questionnaire. Those less prone to emotional upsets or worrying performed better at multi-task monitoring than individuals who were more reactive and sensitive to criticism. When age, education level, and neuroticism were included in the model, 32.5% of the variance was explained.

Cluster analysis was used to examine the effect of individual differences on the performance outcome. An analysis of the Situational Self-Efficacy (SSE) variable revealed two distinct groups of individuals with high and low levels of confidence in their ability to do well. *Post hoc* analyses indicated that individuals who reported high SSE performed significantly better at multi-task monitoring than those who reported lower SSE levels.

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## 1. Introduction

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The U.S. Army's Future Force (FF) will be required to perform multiple competing cognitive tasks simultaneously in information-rich environments where Soldiers may become overloaded and may perform one or more of the tasks poorly, especially if performance of one task interferes with performance of one or more of the others. Therefore, it is important to understand the impact and limitations of multi-tasking on human performance so that standards can be developed for optimizing Soldier performance in proposed Future Combat Systems (FCS). It is not acceptable to base those standards on measures derived from the quantification of human performance of individual tasks. Quantifying performance of a complete set of tasks is fundamentally different than quantifying performance of each task separately, and so it is necessary to measure performance in an environment that requires handling multiple tasks simultaneously.

The directive for this research originated from an initial request from the Office of the Deputy Chief of Staff of Training (DCST) at Headquarters Training and Doctrine Command (TRADOC), asking the U.S. Army Research Laboratory's (ARL's) Human Research and Engineering Directorate to provide information about the impacts of multi-tasking on human performance. The literature survey conducted within ARL's Cognitive Sciences Branch resulted in an information paper that identified an Army need for research to be conducted to investigate individual and group differences in multi-task performance. ARL recommended that these studies include within-groups differences, measures of self-efficacy, and other resiliency measures to assist in determining the mediators of multi-task performance.

One factor that has been shown to affect performance in multi-task environments is age. Previous research has indicated that older adults (i.e., 60 years and older) perform more poorly in multiple-task environments than do younger adults (20 to 39 years of age), but there are several explanations for this decline (McDowd, 1986; Sit & Fisk, 1999). The amount of attentional capacity required by the tasks, the division of attention, the complexity of the tasks, and the mode of information processing required are all factors that have been shown to affect age-related performance (McDowd, 1986; Korteling, 1994; Salthouse & Coon, 1994; Salthouse, Mitchell, Skovronek, & Babcock, 1989; Sit & Fisk, 1999). However, this question remains: Are the performance degradations a result of aging or of old age? Within the Army, it is important to answer this question to determine if differences in age in military-effective target audiences (META), that is, ages 18 through 55, have an effect upon performance in multi-task environments. That is, can performance be expected to remain the same across all age groups? If not, can poor performers improve with practice, regardless of their age? Salthouse (1990) found that as more demands were placed on available processing resources, older adults showed greater impairment of performance than younger adults. However, Sit and Fisk (1999) found that this age-related gap in performance decreased with practice. Will this same effect occur across all age groups within a META?

Another factor that may have an effect on multi-task performance is personality. As part of previous research directed by the Defense Women's Health Research Program through the U.S. Army Medical Research and Materiel Command, studies were conducted to investigate the effects of sustained operations (SUSOPS) on male and female Soldier performance. One aspect of the SUSOPS research focused on individual personality differences and the effects on cognitive performance (Mullins & Fatkin, 1999). As expected, there were no gender differences in personality characteristics. However, results indicated significant differences in cognitive performance for individuals scoring high on the Impulsive-Sensation Seeking subscale. Although they initially performed better for the short-term memory and the logical reasoning tasks, this effect was not maintained throughout the sustained operations period.

In a study using a dual-task paradigm, Ball and Zuckerman (1992) found that high sensation seekers performed better in the primary task. There was also no trade-off between their stronger attention to the primary task and their performance of the peripheral task. However, it is not clear whether performance would diminish if sustained attention were required (Brocke, Beauducel, & Tasche, 1999).

Potosky (2002) reported that the role of individual personality differences has received an inadequate amount of attention in the assessment of performance of multiple computer tasks. Individual differences in temperament, such as risk-taking components, have been predictive of workload perception and preferences. Research conducted by Driskell and Salas (1996) indicated that gains in predicting effective performance will come from advances in understanding personality characteristics. For example, differences in an impulsive dimension might be a factor when speed is favored over accuracy for dynamic tasks. Likewise, individuals who tend to perceive the multi-tasking scenario as a challenge may perform better than individuals who perceive the multiple tasks as threatening or highly frustrating distractions.

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## **2. Objectives**

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This basic research effort was directed toward increasing fundamental knowledge and understanding of the factors affecting multi-task performance. Information gathered from this study will be used in subsequent research that will ultimately contribute to the development of standards for proposed FCS. The primary objective of this laboratory experiment was to identify and quantify the effects of individual differences (i.e., personality characteristics, age, demographics, self-efficacy) on human performance in a multi-task environment. The secondary objective was to observe the effects of previous computer experience and the amount of practice on the performance task (SYNWORK [Synthetic Work Environment] trials) and to determine which relationships exist between personality and self-efficacy traits and multi-task performance.

It was hypothesized that younger adults would perform better than those in other age groups. However, we anticipated that any initial differences in performance across age groups would decrease with practice.

It was also hypothesized that significant differences in multi-task performance would be related to individual personality differences.

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### **3. Method**

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#### **3.1 Test Participants**

A total of 76 male and female civilian and military volunteers participated in this study. Participants ranged in age from 18 through 55 years. They were carefully selected to ensure a sampling from the entire age range rather than a cluster at one end of the range. Participants had various degrees of computer experience and no previous experience using the performance measurement tool.

#### **3.2 Apparatus**

Participants used SYNWORK, a computer-based synthetic work environment that runs on a personal desktop computer or a laptop (Elsmore, 1994). They were required to work simultaneously on four distinct tasks that were presented on a computer screen: Sternberg memory, three-column addition, visual tracking, and signal discrimination. These tasks required continuous attention and involved memory, arithmetic processing, and visual and auditory monitoring.

Each SYNWORK task is presented in a separate quadrant on the screen (see figure 1). The memory task, in the upper left quadrant, consists of an initial display of a five-character alphabetic memory set that remains on the screen for the first 10 seconds of each trial. The memory set remains the same for each trial but varies across trials. After the memory set is removed from the display, a probe letter is displayed periodically. The participant must determine whether this letter is a member of the memory set and must respond “yes” or “no”.

The arithmetic task, in the upper right quadrant, is a self-paced task requiring the addition of two three-digit numbers. Participants use a mouse to adjust plus or minus buttons to achieve the correct solution.

The visual tracking task, in the lower left quadrant, requires participants to monitor the position of a vertical bar that moves along a horizontal scale. Participants use a mouse to reset the bar before it reaches one of the ends of the scale.

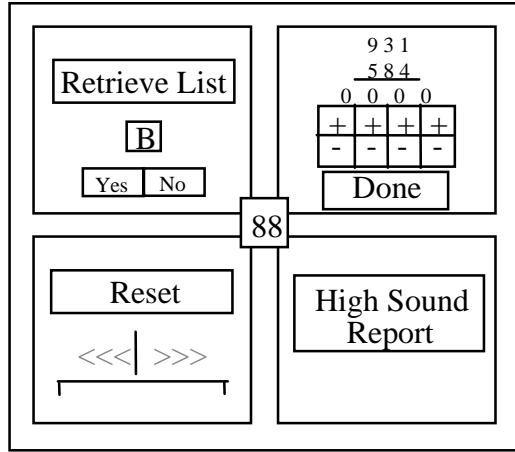


Figure 1. The SYNWORK screen.

In the signal discrimination task, high (2092 Hz) and low tones (523 Hz) are presented periodically through headphones worn by the participants. The task requires the use of a mouse to respond whenever a high tone is presented.

Participants were required to complete a demographics questionnaire (appendix B) that requested information about age, gender, vision and hearing, military service, education level, and computer experience, which includes frequency and length of use.

Participants also completed a pencil-and-paper 10-item polychronicity scale (appendix C). This scale was used to determine the extent to which individuals prefer working on several tasks at once as opposed to working on only one task at a time (Bluedorn, Kallith, Strube, & Martin, 1999).

The Zuckerman-Kuhlman Personality Questionnaire-Form III (ZKPQ-III) (appendix D) was administered to identify five components of personality in five subscales: Activity, Aggression-Hostility, Sociability, Neuroticism-Anxiety (N-Anxiety), and Impulsive Risk Taking. This five-factor model is recommended for research involving personality correlates because it provides maximal specificity at no loss in reproducibility across gender and populations (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). The ZKPQ-III is a 99-item, true-false inventory of temperament that is used solely as a research instrument and not as a psychiatric or clinically diagnostic tool. The information obtained from this questionnaire identifies basic dimensions of temperament proposed to correlate with various cognitive skills. Only group data were reported for this study. The internal reliabilities on the five subscales range from 0.72 to 0.86 (Zuckerman et al., 1993).

Participants completed the Situational Self-Efficacy (SSE) scale (appendix E), which was developed for investigating the predictive power of efficacy expectations about behavior or task performance (Bandura, 1977). Participants were asked to rate (from 1 to 10) their level of confidence in their ability to do well. There is extensive evidence that self-efficacy is associated with

higher levels of motivation and performance for civilian and military populations (Fatkin & Hudgens, 1994; Potosky, 2002).

### **3.3 Procedures**

During the participant recruitment phase, a script describing the purpose and procedures of the study was read to all potential volunteers (appendix F). Before testing, all participants were re-briefed about the purpose and procedures of the study and were read the volunteer agreement affidavit (appendix A). Potential volunteers were given the required brief regarding confidentiality as indicated on Department of Army Form 5303-R.

Participants signed the volunteer agreement affidavit and were screened to ensure no hearing impairments and 20/20 corrected or uncorrected vision. They then completed the demographic questionnaire, polychronicity scale, the ZKPQ-III, and the SSE scale.

After receiving verbal instructions and a demonstration of each SYNWORK task, participants completed two 5-minute training sessions, each followed by a 5-minute break. Participants then completed four 12-minute trials with a mandatory 5-minute break between each trial.

SYNWORK was administered to groups of no more than three participants at a time. Each volunteer was provided with a laptop and a set of headphones. Adequate spacing between participants was provided to ensure a workspace free of auditory and visual distractions.

Participants were not given any instructions concerning priority of the four tasks. They were instructed to complete each task as quickly and as accurately as possible without priority.

### **3.4 Experimental Design**

The experimental design consisted of a 4 (Age Group) x 4 (Trial) mixed factorial design. Age Group was the between-subjects variable and consisted of groups of participants within the following age categories: (a) 18 to 25 years, (b) 26 to 35 years, (c) 36 to 45 years, and (d) 46 to 55 years. Trial was the within-subjects factor; participants completed four 12-minute trials with a mandatory 5-minute break between each trial.

The SYNWORK dependent measure was the overall score in each trial and was based on the total points obtained as a function of time to complete each task and number of correct and incorrect responses. Individual task scores were not considered because participants were instructed to treat all four tasks with equal importance. Responses from the demographics questionnaire, the polychronicity scale, the SSE scale, and the ZKPQ-III were correlated with the performance measures to determine which variables contributed to successful multi-tasking.

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## 4. Results

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Throughout the data collection period, several data points were lost because of equipment malfunction or operator error. This resulted in unequal N's across groups but did not result in reduced significance in the reported findings.

### 4.1 Effects of Age and Practice on Multi-task Performance

Our primary hypothesis was that younger adults would perform better in the multi-task operations than the other age groups. We also expected that any initial age difference between the groups would diminish with practice gained over the four trials. Multivariate analyses of variance (MANOVAs) were used to examine the effects of age and trial on multi-task performance. A 0.05 criterion level for significance was employed throughout the analyses. The homogeneity of variance assumption for these analyses was confirmed. *Post hoc* comparisons were also made for significant results through the Least Significant Difference (LSD) test.

A MANOVA conducted with the four total scores (from trial 1 through trial 4) for the four age groups revealed a significant Age Group effect (Wilks'  $\lambda = .691$ ;  $F (12, 148) = 1.858$ ;  $p = .044$ ), with a significant effect for Age Group during Trial 2 ( $F (3, 59) = 3.148$ ;  $p = .032$ ) and during Trial 4 ( $F (3, 59) = 2.804$ ;  $p = .047$ ). Figure 2 depicts the significant differences for Trials 2 and 4, as well as the significant effects found between the second youngest age group (26 to 35) and the oldest group (46 to 55) when multiple comparisons within trials were performed.

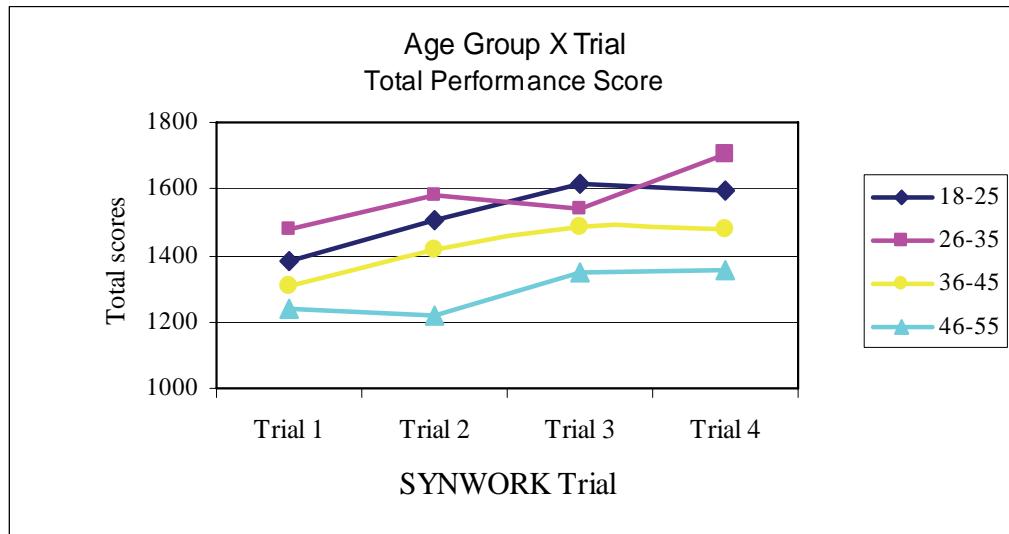


Figure 2. SYNWORK total scores across all four trials for each age group.

It is interesting to note that the pattern of performance scores across trials is different for the second youngest group (26 to 35). All other age groups improved their performance scores throughout Trials 1 through 3, then maintained that level during Trial 4. Although not statistically

different, the second group decreased performance between Trials 2 and 3, then improved for a point span of over 160 from Trial 3 to Trial 4.

## 4.2 Demographic Factors

Spearman's rank-order correlation coefficients were computed on a trial-by-trial basis to determine relationships between demographic factors (i.e., age, education level, previous computer experience) and personal characteristics (polychronicity, self-efficacy, personality traits) with multi-task performance. Age showed a significant negative correlation with the overall SYNWORK scores for Trial 2 ( $r(66) = -.316, p = .010$ ), Trial 3 ( $r(67) = -.247, p = .044$ ), and Trial 4 ( $r(69) = -.281, p = .020$ ), indicating that performance decreased as age increased.

A secondary objective of the study was to observe the effects of previous computer experience to determine which relationships exist between experience, frequency of use, and multi-task performance. As indicated in table 1, the frequency of computer use was negatively correlated with performance in Trials 2, 3, and 4 but not in Trial 1. Additionally, a significant and positive correlation was found between the amount of the participants' computer experience and the total SYNWORK score in Trial 2.

Table 1. Correlations between total multi-task performance scores and computer experience.

Computer Experience	Trial 1	Trial 2	Trial 3	Trial 4
How long using computer?	.172	.269*	.213	.204
How often using computer?	-.214	-.368*	-.291*	-.255*

\* $p < .05$ .

### 4.2.1 Polychronicity

Items 2, 4, and 5 (appendix C) of the polychronicity inventory were found to be positively correlated with SYNWORK scores,  $r(249) = .209, p < .01$ ,  $r(249) = .143, p < .05$ , and  $r(249) = .188, p < .01$ , respectively. Participants who preferred working on several projects at a time scored higher overall on the SYNWORK tasks. In addition, they preferred to complete parts of several projects every day rather than completing an entire project.

Furthermore, a significant positive trend was found between SSE and items 1, 3, 7, and 9 of the polychronicity scale,  $r(276) = .226, p < .01$ ,  $r(280) = .229, p < .01$ ,  $r(280) = .204, p < .01$ , and  $r(280) = .187, p < .02$  respectively. Those who reported higher levels of confidence in their ability to do well showed a preference for working on parts of several tasks at one time rather than completing one task before beginning another.

### 4.2.2 Situational Self-Efficacy (SSE)

To address the effect of individual variability in self-efficacy on multi-task performance, cluster analysis was performed. This is a method of statistically grouping individuals, based on the

similar characteristics. It minimizes the variance for each cluster across the measure so that the result is groups or clusters of individuals who are most alike.

With the total SYNWORK scores for each trial in the cluster analysis, two subgroups of people with distinct levels of efficacy were revealed. Within a potential range of scores from 1 to 10, the “high SSE” group rated themselves as having efficacy levels of 8.6 through 10. The “low SSE” group perceived their levels of confidence to be lower than 6.5. The F statistic was significant,  $F(1,68) = 102.183, p < .001$ , indicating that efficacy provided a critical contribution to the evaluation of individual variability.

A *post hoc* two-way ANOVA (SSE group by trial) using the two efficacy groups revealed significant differences in performance between the clusters. As illustrated in figure 3, the high SSE group performed significantly better in multi-task monitoring during Trial 1 ( $F(1, 59) = 5.65, p = .021$ ), Trial 2 ( $F(1, 59) = 4.82, p = .032$ ), and Trial 3 ( $F(1, 59) = 4.66, p = .035$ ). Although the performance of the high SSE group remained higher than the low SSE group during Trial 4, the difference between the groups was not statistically significant ( $F(1, 59) = 3.64, p = .061$ ).

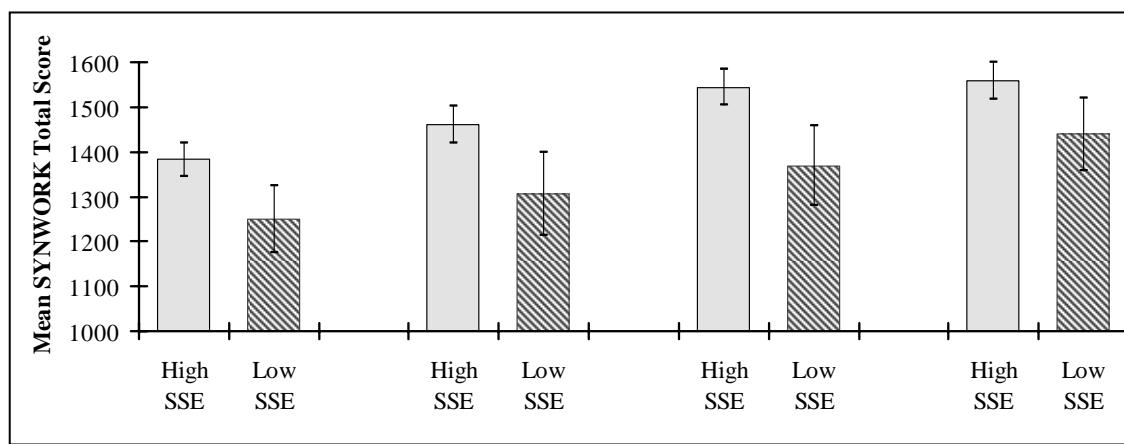


Figure 3. SYNWORK total scores across all four trials for high and low self-efficacy groups.

SSE was also significantly and positively correlated with individual education levels ( $r(70) = .277, p = .020$ ). The higher level of education attained by a participant, the higher s/he perceived his or her level of confidence in the ability to do the task well.

### 4.3 Personality Factors

There were also significant correlations between SSE and two personality measures derived from the ZKPQ-III: the Activity subscale ( $r(70) = .236, p = .049$ ) and the N-Anxiety subscale ( $r(70) = -.367, p = .002$ ).

N-Anxiety, one major dimension of personality obtained from the ZKPQ-III, is also described as emotional lability and seems to be a good predictor of performance. N-Anxiety scores were

significantly and negatively correlated with the total SYNWORK scores for Trials 1 through 4, as indicated in table 2.

Table 2. Correlations between N-Anxiety scores and total SYNWORK performance scores.

Personality scale	Trial 1	Trial 2	Trial 3	Trial 4
N-Anxiety	$r = -.241, p = .047$	$r = -.281, p = .022$	$r = -.238, p = .052$	$r = -.250, p = .038$

Generally, individuals who exhibited lower levels of N-Anxiety performed better at multi-task monitoring than those who exhibited higher levels.

#### 4.4 Performance Predictors

In order to analyze the relationship between the independent variables as predictors and the performance criterion variables, multiple regression analyses were conducted. These analyses were used to examine the effects of individual differences on multi-task (M-T) performance outcomes. For example, stepwise multiple regression analyses were conducted to evaluate how well personality characteristics and demographic information (e.g., age, previous experience with computers, etc.) predicted the performance scores.

The first set of predictors included the subscales of the ZKPQ-III: Activity, Aggression-Hostility, Sociability, Neuroticism-Anxiety (N-Anxiety), and Impulsive Risk Taking, as well as age and level of education. The regression coefficients ( $B$  coefficients) represent the contributions of each independent variable to the prediction of the dependent variable, the total SYNWORK performance score. The criterion variable for the first stepwise regression was the M-T total score for Trial 1 (M-T Total1).

Similar regression models were constructed with the M-T Total score from each of the other three trials: M-T Total2, M-T Total3, and M-T Total4 as the criterion variables. The results are reported in table 3.

Table 3. Multiple regression models of multi-task performance for trials 1 through 4.

Outcome Variable	Std $\beta$ Weights for Significant Predictors	R	$R^2, p$
Trial 1, Total Score	$-.241^*N-Anx$	.241	$.058, p = .047$
Trial 2, Total Score	$-.474^*Age + .357^*Educ Level + -.311^*N-Anx$	.570	$.325, p < .001$
Trial 3, Total Score	$-.327^*N-Anx + -.289^*Age$	.395	$.156, p = .005$
Trial 4, Total Score	$-.333^*N-Anx + -.304^*Age$	.415	$.172, p = .002$

R= Multiple correlation coefficient; N-Anx= Neuroticism-Anxiety; Educ Level= Education Level

The variable that is consistently retained at the end of the stepwise regression analyses is the N-Anxiety subscale of the personality questionnaire. Those people less prone to emotional upsets or worrying performed better at multi-task monitoring than individuals who were more reactive and sensitive to criticism. As noted in table 3, the multiple correlation coefficients for the models include N-Anx range from .241 to .570. When age and education level were included in the

model as significant predictors of performance, the squared multiple correlations increase, allowing us to predict as much as 32.5% of the variance in overall performance.

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## 5. Discussion

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Consistent with our expectations, it was found that younger adults performed better in multi-task performance; however, with practice, performance improved across all age groups. This reinforces findings reported by Salthouse (1990) that as more demands were placed on available processing resources, older adults showed greater impairment of performance than younger adults.

One of the stated objectives of the study was to observe the effects of previous computer experience to determine which relationships exist between experience, frequency of use, and multi-task performance. Significant and positive correlations were found between the amount of the participants' computer experience and their overall total scores. However, a significant and negative correlation was found between the participants' frequency of computer use and their total scores on Trial 2.

At first glance, it is difficult to understand that although individuals with more computer experience performed better in multiple tasks than those with less experience, individuals who reported frequent use of their computers did not perform as well as those with less frequent use. Although the latter result seems counter-intuitive, the explanation may lie in the *quality* of their computer experience versus the *quantity* of contact. Todman and Drysdale (2004) address this issue in their recent study of the effects of qualitative differences in initial and subsequent computer experiences. They concluded that the effects of good and bad computer experiences were less dependent on the *number* of these experiences than on the *quality* of their impact. Beckers and Schmidt (2003) and Smith, Caputi, Crittenden, Jayasuriya, and Rawstorne (1999) also support the notion that quality versus quantity of experience has a significant impact on the individual interactions with technology.

These results suggest that it would be worthwhile to follow a deliberate plan for introducing novices to the world of computer technology, filling their initial experiences with a sense of competence and control. This method is intended to diminish fear of failure and to provide opportunities for them to enhance the development of SSE. From a social cognitive theory perspective, this finding supports Bandura's (1986) proposition that prior experience, especially with respect to difficult and unfamiliar tasks, represents the most significant determinant of self-efficacy beliefs.

Polychronicity has shown to be a positive predictor of performance of the SYNWORK task. Those individuals who showed a preference for working on several tasks at one time had higher

overall scores than those who preferred to complete one project at a time. The former group was better able to switch back and forth between sub-tasks and thereby increased their total score by completing all sub-tasks rather than focusing on only one at a time.

The SSE measure provides an assessment of one's ability to master new situations or ability to adapt to changing circumstances. This ability is considered to be a composite of past success and failure experiences and influences the individual's perception of how s/he might perform military tasks (Sherer, Maddux, Mercandante, Prentice-Dunn, Jacobs, & Rogers, 1982). In this study, participants who scored relatively high on self-efficacy reported being less fearful and less sensitive to criticism than the low-efficacy group. The same participants who reported high levels of confidence also perceived themselves as having a need for activity, with a preference for hard or challenging work, and a high energy level. These findings are also supported by a meta-analysis conducted by Barrick and Mount (1991). Individuals with high achievement levels were also confident, experienced success from past undertakings, and expected to succeed in the future.

Bandura (1977, 1982, 1986) contends that individuals are constantly assessing their range of capabilities and that these assessments significantly guide and influence behavior. When people perceive a circumstance or task as exceeding their ability, they tend to minimize their efforts, perform less effectively, or avoid these situations altogether. On the other hand, when individuals believe the task or adjustment is within their range of capabilities, they invest more effort and tend to persevere even in the face of obstacles or adverse circumstances.

The contribution of individual personality differences to performance of multiple computer tasks must also be acknowledged. In the current study, individuals who exhibited lower levels of neuroticism-anxiety performed better at multi-task monitoring than those who exhibited higher levels. Neuroticism-anxiety is also described as emotional instability, and high scorers are worriers who exhibit strong emotional reactions that do not dissipate quickly (McKelvie, 2004). The effects of individual differences in temperament on other types of multi-tasking jobs have been investigated. One such occupation is the high pressure, intensely demanding job of the air traffic controller. In a review of research conducted by the Civil Aeromedical Institute of the Federal Aviation Association, longitudinal predictions of the effectiveness of air traffic controllers were made, based on scores from personality measures (King, Retzlaff, Detwiler, Schroeder, & Broach, 2003). As in the current study, neuroticism-anxiety and impulsive risk taking were consistent correlates of effective performance. The researchers reported that successful air traffic controller students exhibited lower levels of neuroticism and higher scores of impulsive-sensation seeking than those who were not as successful.

When age, education level, and the neuroticism-anxiety trait are included in the regression model as significant predictors of performance, the squared multiple correlations increase, allowing us to predict as much as 32.5% of the variance in overall performance. This is a significant finding and contributes to the understanding of factors affecting performance. In a recent study of the relationship between personality, approach to learning, and academic performance (Duff, Boyle,

Dunleavy, & Ferguson, 2004), a linear regression analysis was conducted with similar variables. Using the predictor variables of age, prior educational attainment, and conscientiousness, they accounted for 24.1% of the variance in performance.

The development of factorially derived measures of personality within the last decade has placed these measures of temperament within the collection of tools that can be used for personnel development within civilian and military occupations. A multi-dimensional set of tools can be valuable for the identification and development of candidates who possess the necessary knowledge, skills, abilities, and temperament to perform successfully in multi-tasking occupations and who are among the most likely to be retained.

Although multi-tasking is required for a vast majority of occupations, very few studies have employed a multiple-task environment when evaluating performance. Sauer, Wastell, and Hockey (1999) pointed out that single task methods not only have little resemblance to normal duties, but they cannot adequately assess the concurrent completion of several (and sometimes conflicting) tasks.

This research found that certain individual differences correlated with performance in a multi-task environment. Age proved to be a significant predictor. Although older individuals improved performance with practice, younger individuals performed better from the start. Additionally, performance scores were higher for those individuals who have higher levels of confidence in their ability to do well, who show a preference for working on several tasks at a time, and who exhibit lower levels of neuroticism-anxiety.

The use of SYNWORK as a computer-simulated task environment is sufficiently complex and is a valid means for the assessment of basic factors affecting multi-task performance. Future research efforts are planned with military-relevant scenarios and will employ assessment tools that evaluate the significant contributions of demographic factors, temperament, and SSE to the understanding of performance in dynamic and complex operating environments.

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## Appendix A. Volunteer Agreement Affidavit

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### VOLUNTEER AGREEMENT AFFIDAVIT:

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ARL-HRED Local Adaptation of DA Form 5303-R. For use of this form, see AR 70-25 or AR 40-38

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The proponent for this research is:	<b>U.S. Army Research Laboratory Human Research and Engineering Directorate Aberdeen Proving Ground, MD 21005</b>
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Authority:	Privacy Act of 1974, 10 U.S.C. 3013, [Subject to the authority, direction, and control of the Secretary of Defense and subject to the provisions of chapter 6 of this title, the Secretary of the Army is responsible for, and has the authority necessary to conduct, all affairs of the Department of the Army, including the following functions: (4) Equipping (including research and development), 44 USC 3101 [The head of each Federal agency shall make and preserve records containing adequate and proper documentation of the organization, functions, policies, decisions, procedures, and essential transactions of the agency and designed to furnish the information necessary to protect the legal and financial rights of the Government and of persons directly affected by the agency's activities]
Principal purpose:	To document voluntary participation in the Research program.
Routine Uses:	The SSN and home address will be used for identification and locating purposes. Information derived from the project will be used for documentation, adjudication of claims, and mandatory reporting of medical conditions as required by law. Information may be furnished to Federal, State, and local agencies.
Disclosure:	The furnishing of your SSN and home address is mandatory and necessary to provide identification and to contact you if future information indicates that your health may be adversely affected. Failure to provide the information may preclude your voluntary participation in this data collection.

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### Part A • Volunteer agreement affidavit for subjects in approved Department of Army research projects

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**Note: Volunteers are authorized medical care for any injury or disease that is the direct result of participating in this project (under the provisions of AR 40-38 and AR 70-25).**

Title of Research Project:	An Initial Investigation of Factors Affecting Multi-task Performance	
Human Use Protocol Log Number:	ARL-20098-02007	
Principal Investigator(s):	Teresa A. Branscome U.S. Army Research Laboratory Soldier Performance Division Cognitive Sciences Branch	Phone: 410-278-5951 E-Mail: <a href="mailto:tbransco@arl.army.mil">tbransco@arl.army.mil</a>
Associate Investigator(s)	Jennifer C. Swoboda Linda T. Fatkin U.S. Army Research Laboratory Soldier Performance Division Cognitive Sciences Branch	Phone: 410-278-5948 410-278-5987 E-Mail: <a href="mailto:jcrouch@arl.army.mil">jcrouch@arl.army.mil</a> <a href="mailto:lfatkin@arl.army.mil">lfatkin@arl.army.mil</a>
Location of Research:	Aberdeen Proving Ground, MD	
Dates of Participation:	April 29 2002 thru June 1, 2003	

I do hereby volunteer to participate in the research project described in the table above. I have full capacity to consent and have attained my 18th birthday. The implications of my voluntary participation, duration, and purpose of the research project, the methods and means by which it is to be conducted, and the inconveniences and hazards

that may reasonably be expected have been explained to me. I have been given an opportunity to ask questions concerning this research project. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights or project related injury, I may contact the **ARL-HRED Human Use Committee Chairperson at Aberdeen Proving Ground, Maryland, USA by telephone at 410-278-0612 or DSN 298-0612**. I understand that any published data will not reveal my identity. If I choose not to participate, or later wish to withdraw from any portion of it, I may do so without penalty. I understand that military personnel are not subject to punishment under the Uniform Code of Military Justice for choosing not to take part as human volunteers and that no administrative sanctions can be given me for choosing not to participate. I may at any time during the course of the project revoke my consent and withdraw without penalty or loss of benefits. However, I may be required (military volunteer) or requested (civilian volunteer) to undergo certain examinations if, in the opinion of an attending physician, such examinations are necessary for my health and well being.

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#### **Part B • To be completed by the Principal Investigator**

Note: Instruction for elements of the informed consent provided as detailed explanation in accordance with Appendix C, AR 40-38 or AR 70-25.

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#### **Purpose of the Research**

The purpose of this research project is to study performance on a task which involves attending to four tasks at once. The task, SYNWORK (Synthetic Work Environment), will be presented on a computer.

#### **Procedures**

If you agree to participate in this study, you will be asked to sign this Volunteer Agreement Affidavit and you will be screened to ensure no hearing impairments and 20/20 corrected or uncorrected vision.

After receiving verbal instructions and a demonstration of each SYNWORK task, you will complete two five-minute training sessions each followed by a five-minute break. You will then complete four 12-minute test trials with a mandatory five-minute break between each trial.

You will be required to complete a demographics questionnaire. It will solicit information regarding age, gender, vision and hearing, military service, and computer experience. You will also complete a pencil and paper ten-item polychronicity scale. This scale will be used to determine the extent to which individuals prefer working on several tasks at once as opposed to working on only one task at a time.

The Zuckerman-Kuhlman Personality Questionnaire-Form III will be administered to identify five components of personality in five subscales: Activity, Aggression-Hostility, Sociability, Neuroticism-Anxiety, and Impulsive Risk Taking. Lastly, you will complete the Situational Self-Efficacy (SSE) scale, in which you will be asked to rate (from 1 to 10) your level of confidence in your ability to do well

#### **Benefits**

You will receive the personal satisfaction of supporting Army cognitive sciences research.

#### **Risks**

The risks that will be encountered in this study are minimal and typical of the everyday risks encountered by military and civilian personnel performing office duties using their computers. The familiarization period and the test sessions will be conducted indoors.

If any problems occur during the study, please inform the investigators immediately. You may be told to stop your activity until the problems are resolved.

## Confidentiality

All data and information obtained about you will be considered privileged and held in confidence. Photographic or video images of you taken during this data collection will not be identified with any of your personal information (name, rank, or status). All examinations will be recorded using a volunteer identifier code and a separate file with your consent form and the Principal Investigator will keep your assigned volunteer identifier code in a locked cabinet. Complete confidentiality cannot be promised, particularly if you are a military service member, because information bearing on your health may be required to be reported to appropriate medical or command authorities. In addition, applicable regulations note the possibility that the U.S. Army Medical Research and Materiel Command (MRMC-RCQ) officials may inspect the records. In order to ensure that your data will not be reported or revealed to anyone, each form will be reviewed upon receipt by one of the investigators. If any identifying information appears on the questionnaires (such as name, social security number, birth date, etc.), the investigators will delete the identifying information and replace it with a neutral code number.

## Disposition of Volunteer Agreement Affidavit

The Principal Investigator will retain the original signed Volunteer Agreement Affidavit and forward a photocopy of it to the Chair of the Human Use Committee after the data collection. The test administrator will provide a copy to the volunteer.

## Contacts for Additional Assistance

If you have questions concerning your rights on research-related injury, or if you have any complaints about your treatment while participating in this research, you can contact:

Chair, Human Use Committee  
U.S. Army Research Laboratory  
Human Research and Engineering Directorate  
Aberdeen Proving Ground, MD 21005  
(410) 278-0612 or (DSN) 298-0612

**OR** Office of the Chief Counsel  
U.S. Army Research Laboratory  
2800 Powder Mill Road  
Adelphi, MD 20783-1197  
(301) 394-1070 or (DSN) 290-1070

**Your signature below indicates that you: (1) are at least 18 years of age, (2) have read the information on this form, (3) have been given the opportunity to ask questions and they have been answered to your satisfaction, and (4) have decided to participate based on the information provided on this form.**

<i>Printed Name of Volunteer (First, MI., Last)</i>	
<i>Social Security Number (SSN)</i>	<i>Permanent Address of Volunteer</i>
<i>Date of Birth (Month, Day, Year)</i>	
<i>Today's Date (Month, Day, Year)</i>	<i>Signature of Volunteer</i>
<i>Signature of Administrator</i>	

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## Appendix B. Demographic and Computer Experience Questionnaire

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### Demographic and Computer Experience Questionnaire

1. AGE: \_\_\_\_\_
2. GENDER:  Male  Female
3. Do you wear glasses?  Yes  No
4. Is your vision corrected to 20/20 with eyeglasses or contacts?  Yes  No
5. Do you have an apparent hearing impairment?  Yes  No
6. Please indicate your highest level of education:  
 High School Diploma  
 Undergraduate Degree  
 Some graduate courses  
 Graduate Degree  
 Other
7. Are you in the Army?  Yes  No  
If yes, for how many years?  Less than 5 years  5-10 years  11-15 years  16-20 years  20 years or more  
What is your rank? \_\_\_\_\_ What is your MOS? \_\_\_\_\_

8. Does your job require you to use a computer on a regular basis?  Yes  No

9. How long have you been using a computer?

Less than 1 year  1-3 years  4-6 years  7-10 years  10 years or more

10. How often do you use a computer?

Daily  Weekly  Monthly  Once or twice a year

10. Do you have a computer in your house?  Yes  No

11. Do you use the computer to play games?  Yes  No

If yes, how often?  Daily  Weekly  Monthly  Once or twice a year

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## Appendix C. Polychronicity Scale

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### Polychronicity Scale

Directions: Please circle one rating for each statement that reflects how you feel.

(1) I like to juggle several activities at the same time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(2) I would rather complete an entire project every day than complete parts of several projects.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(3) I believe people should try to do many things at once.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(4) When I work by myself, I usually work on one project at a time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(5) I prefer to do one thing at a time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(6) I believe people do their best work when they have many tasks to complete.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(7) I believe it is best to complete one task before beginning another.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(8) I believe it is best for people to be given several tasks and assignments to perform.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(9) I seldom like to work on more than a single task or assignment at the same time.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

(10) I would rather complete parts of several projects every day than complete an entire project.

1	2	3	4	5	6	7
Strongly Disagree	Moderately Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Moderately Agree	Strongly Agree

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## Appendix D. Zuckerman-Kuhlman Personality Questionnaire - Form III (ZKPQ-III)

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### ZKPQ III

**DIRECTIONS:** On the following pages you will find a series of statements that persons might use to describe themselves. Read each statement and decide whether or not it describes you. Then mark each statement as either True (T) if you agree with the statement or if it describes you, or False (F) if you disagree with the statement or if it does not describe you. Answer every statement even if you are not entirely sure of your answer.

- 1. I tend to begin a new job without much advance planning on how I will do it.
- 2. I do not worry about unimportant things.
- 3. I enjoy seeing someone I don't care for humiliated before other people.
- 4. I never met a person that I didn't like.
- 5. I do not like to waste time just sitting around and relaxing.
- 6. I usually think about what I am going to do before doing it.
- 7. I am not very confident about myself or my abilities.
- 8. When I get mad, I say ugly things.
- 9. I tend to start conversations at parties.
- 10. I have always told the truth.
- 11. It's natural for me to curse when I am mad.
- 12. I do not mind going out alone and usually prefer it to being out in a large group.
- 13. I lead a busier life than most people.
- 14. I often do things on impulses.
- 15. I often feel restless for no apparent reason.
- 16. I almost never litter the streets with wrappers.
- 17. I would not mind being alone in a place for some days without any human contacts.
- 18. I like complicated jobs that require a lot of effort and concentration.

- \_\_\_\_ 19. I very seldom spend much time on the details of planning ahead.
- \_\_\_\_ 20. I sometimes feel edgy and tense.
- \_\_\_\_ 21. I almost never feel like I would like to punch or slap someone.
- \_\_\_\_ 22. I spend as much time with my friends as I can.
- \_\_\_\_ 23. I do not have a great deal of energy for life's more demanding tasks.
- \_\_\_\_ 24. I like to have new and exciting experiences and sensations even if they are a little frightening.
- \_\_\_\_ 25. My body often feels all tightened up for no apparent reason.
- \_\_\_\_ 26. I always win at games.
- \_\_\_\_ 27. I often find myself being "the life of the party."
- \_\_\_\_ 28. I like a challenging task much more than a routine one.
- \_\_\_\_ 29. Before I begin a complicated job, I make careful plans.
- \_\_\_\_ 30. I frequently get emotionally upset.
- \_\_\_\_ 31. If someone offends me, I just try not to think about it.
- \_\_\_\_ 32. I have never been bored.
- \_\_\_\_ 33. I like to be doing things all of the time.
- \_\_\_\_ 34. I would like to take off on a trip with no preplanned or definite routes or timetable.
- \_\_\_\_ 35. I tend to be oversensitive and easily hurt by thoughtless remarks and actions of others.
- \_\_\_\_ 36. In many stores you just cannot get served unless you push yourself in front of other people.
- \_\_\_\_ 37. I do not need a large number of casual friends.
- \_\_\_\_ 38. I can enjoy myself just lying around and not doing anything active.
- \_\_\_\_ 39. I enjoy getting into new situations where you can't predict how things will turn out.
- \_\_\_\_ 40. I never get lost, even in unfamiliar places.
- \_\_\_\_ 41. I am easily frightened.
- \_\_\_\_ 42. If people annoy me I do not hesitate to tell them so.
- \_\_\_\_ 43. I tend to be uncomfortable at big parties.
- \_\_\_\_ 44. I do not feel the need to be doing things all of the time.
- \_\_\_\_ 45. I like doing things just for the thrill of it.

- \_\_\_\_ 46. I sometimes feel panicky.
- \_\_\_\_ 47. When I am angry with people I do not try to hide it from them.
- \_\_\_\_ 48. At parties, I enjoy mingling with many people whether I already know them or not.
- \_\_\_\_ 49. I would like a job that provided a maximum of leisure time.
- \_\_\_\_ 50. I tend to change interests frequently.
- \_\_\_\_ 51. I often think people I meet are better than I am.
- \_\_\_\_ 52. I never get annoyed when people cut ahead of me in line.
- \_\_\_\_ 53. I tend to start my social weekends on Thursday evenings.
- \_\_\_\_ 54. I usually seem to be in a hurry.
- \_\_\_\_ 55. I sometimes like to do things that are a little frightening.
- \_\_\_\_ 56. Sometimes when emotionally upset I suddenly feel as if my legs are unsteady.
- \_\_\_\_ 57. I generally do not use strong words even when I am angry.
- \_\_\_\_ 58. I would rather "hang out" with friends rather than work on something by myself.
- \_\_\_\_ 59. When on vacation I like to engage in active sports rather than just lie around.
- \_\_\_\_ 60. I'll try anything once.
- \_\_\_\_ 61. I often feel unsure of myself.
- \_\_\_\_ 62. I can easily forgive people who have insulted me or hurt my feelings.
- \_\_\_\_ 63. I would not mind being socially isolated in some place for some period of time.
- \_\_\_\_ 64. I like to wear myself out with hard work or exercise.
- \_\_\_\_ 65. I would like the kind of life where one is on the move and traveling a lot, with lots of change and excitement.
- \_\_\_\_ 66. I often worry about things that other people think are unimportant.
- \_\_\_\_ 67. When people disagree with me I cannot help getting into an argument with them.
- \_\_\_\_ 68. Generally, I like to be alone so I can do things I want to do without social distractions.
- \_\_\_\_ 69. I never have any trouble understanding anything I read the first time I read it.
- \_\_\_\_ 70. I sometimes do "crazy" things just for fun.
- \_\_\_\_ 71. I often have trouble trying to make choices.

- 72. I have a very strong temper.
- 73. I have never lost anything.
- 74. I like to be active as soon as I wake up in the morning.
- 75. I like to explore a strange city or section of town by myself, even if it means getting lost.
- 76. My muscles are so tense that I feel tired much of the time.
- 77. I can't help being a little rude to people I do not like.
- 78. I am a very sociable person.
- 79. I prefer friends who are excitingly unpredictable.
- 80. I often feel like crying sometimes without a reason.
- 81. No matter how hot or cold it gets, I am always quite comfortable.
- 82. I need to feel that I am a vital part of a group.
- 83. I like to keep busy all the time.
- 84. I often get so carried away by new and exciting things and ideas that I never think of possible complications.
- 85. I don't let a lot of trivial things irritate me.
- 86. I am always patient with others even when they are irritating.
- 87. I usually prefer to do things alone.
- 88. I can enjoy routine activities that do not require much concentration or effort.
- 89. I am an impulsive person.
- 90. I often feel uncomfortable and ill at ease for no real reason.
- 91. I often quarrel with others.
- 92. I probably spend more time than I should socializing with friends.
- 93. It doesn't bother me if someone takes advantage of me.
- 94. When I do things, I do them with lots of energy.
- 95. I like "wild" uninhibited parties.
- 96. After buying something I often worry about having made the wrong choice.
- 97. When people shout at me, I shout back.

\_\_\_\_ 98. I have more friends than most people do.

\_\_\_\_ 99. Other people often urge me to "take it easy."

END OF THIS FORM - THANK YOU

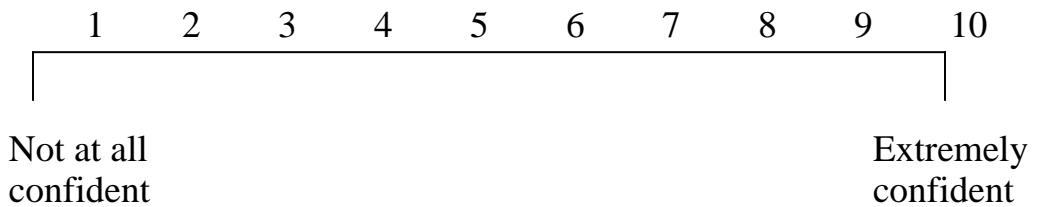
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## Appendix E. Situational Self-Efficacy (SSE) Scale

## SSE

On a scale from 1 to 10, how confident are you in your ability to deal with today's experiences?

Please circle one of the numbers below:



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## Appendix F. Recruitment Script

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You are being asked to volunteer in a research project to study performance on a task that involves attending to four sub-tasks at once. The task, SYNWORK1 (Synthetic Work Environment), will be presented on a computer. The benefit you will receive for participating in this study will be the personal satisfaction of supporting Army cognitive sciences research.

Prior to testing, you will be briefed on the purpose and procedures of the study and will be asked to sign a Volunteer Agreement Affidavit. You will be screened to ensure no hearing impairments and 20/20 corrected or uncorrected vision.

You will be required to complete a demographics questionnaire. It will solicit information regarding age, gender, vision and hearing, military service, and computer experience. You will also complete a pencil and paper ten-item polychronicity scale. This scale will be used to determine the extent to which individuals prefer working on several tasks at once as opposed to working on only one task at a time.

The Zuckerman-Kuhlman Personality Questionnaire-Form III will be administered to identify five components of personality in five subscales: Activity, Aggression-Hostility, Sociability, Neuroticism-Anxiety, and Impulsive Risk Taking. Lastly, you will complete the Situational Self-Efficacy (SSE) scale, in which you will be asked to rate (from 1 to 10) your level of confidence in your ability to do well.

After receiving verbal instructions and a demonstration of each SYNWORK1 task, you will complete two five-minute training sessions each followed by a five-minute break. You will then complete four 12-minute test trials with a mandatory five-minute break between each trial.

The risks that will be encountered in this study are minimal and typical of the everyday risks encountered by military and civilian personnel performing office duties using their computers. The familiarization period and the test sessions will be conducted indoors. Total time required for participation in this study will not exceed two and one-half hours.

In order to participate, you must have reached your 18th birthday. You will be given an opportunity to ask questions concerning this research project. Any published data will not reveal your identity. If you choose not to participate, or later wish to withdraw from any portion of the study, you may do so without penalty. Military personnel are not subject to punishment under the Uniform Code of Military Justice for choosing not to take part as human volunteers and no administrative sanctions can be given for choosing not to participate. You may, at any time during the course of the project, revoke your consent and withdraw without penalty or loss of benefits.

All data and information obtained about you will be considered privileged and held in confidence. Photographic or video images of you taken during this data collection will not be identified with any of your personal information (name, rank, or status). All examinations will be recorded using a volunteer identifier code. The Principal Investigator will keep your assigned volunteer identifier code in a locked cabinet.

The Principal Investigator will retain the original signed Volunteer Agreement Affidavit and forward a photocopy of it to the Chair of the Human Use Committee after the data collection. The test administrator will provide a copy to the volunteer.

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